ESERCIZIO FISICO

Francesco LANDI
Centro Medicina dell'Invecchiamento
Università Cattolica del Sacro Cuore, Roma

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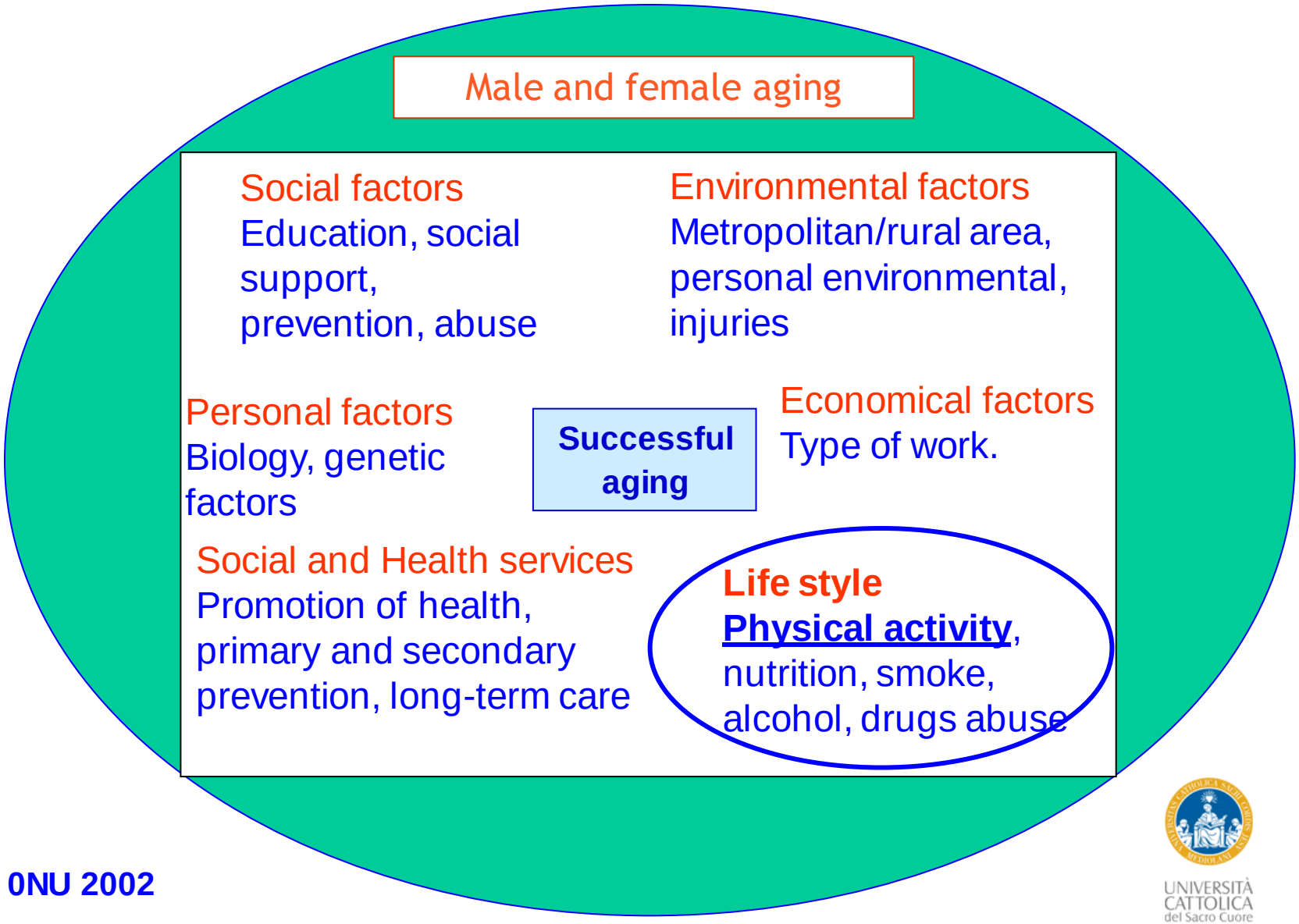
Factors for successful aging



0NU 2002

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Successful aging in islands

- Sardegna (IT)
- Okinawa (J)
- Creta
- Loma Linda (Ca – US)
- Cuba

Common life-style

No smoking

Family in center of your life

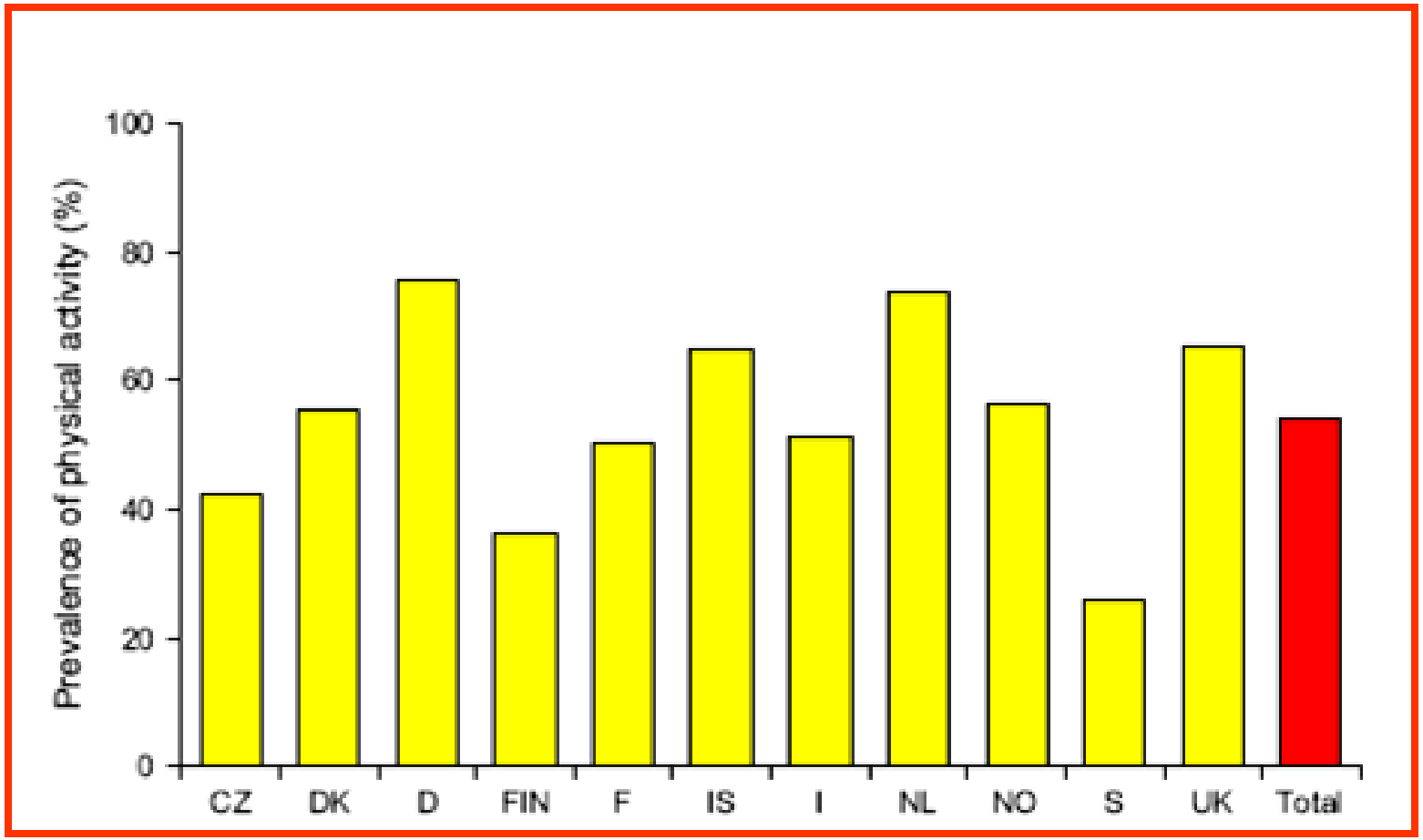
Be active every day

Involved in social activities

Fruits, vegetables, cereals

Ben-Shlomo, 2002

Prevalence of physical activity for two or more hours during the last 3 days by Country



Landi et al. *J Clin Epidemiol 2007;60:518*

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Prevalence of physical activity in USA

Physical Activity in U.S. Adults
Compliance with the Physical Activity Guidelines for Americans

In 2008,… 90.6% of older adults did not participate in the minimum recommended levels of both aerobic and muscle-strengthening activities.

Carlson et al. *Am J Prev Med* 2010;39:305-313

Proportion of …	… /wk)
Self-Report	46.9
Accelerometry	6.3

73.6±3.9 minutes/week of vigorous physical activity, although accelerometry estimates were 45.1±4.6 minutes/week of moderate physical activity and 18.6±6.6 minutes/week of vigorous physical activity. The proportion of adults meeting the PAGA according to M2VPA was 62.0% for self-report and 9.6% for accelerometry.

Conclusions: According to the NHANES 2005–2006, fewer than 10% of U.S. adults met the PAGA according to accelerometry. However, physical activity estimates vary substantially depending on whether self-reported or measured via accelerometer.

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Global benefits of physical exercise

- **PHYSICAL ACTIVITY AND HYPERTENSION: prevention and treatment**
- **PHYSICAL ACTIVITY AND DIABETES: prevention and treatment**
- **PHYSICAL ACTIVITY AND HEART FAILURE and CHD: quality of life**
- **PHYSICAL ACTIVITY AND STROKE: less incidence and rehabilitation**
- **PHYSICAL ACTIVITY AND COPD: rehabilitation**
- **PHYSICAL ACTIVITY AND HIP FRACTURE: prevention of osteoporosis and falls**
- **PHYSICAL ACTIVITY AND NEUROLOGICAL DISORDERS: dementia and depression**
- **PHYSICAL ACTIVITY AND MUSCLE HEALTH prevention and treatment**

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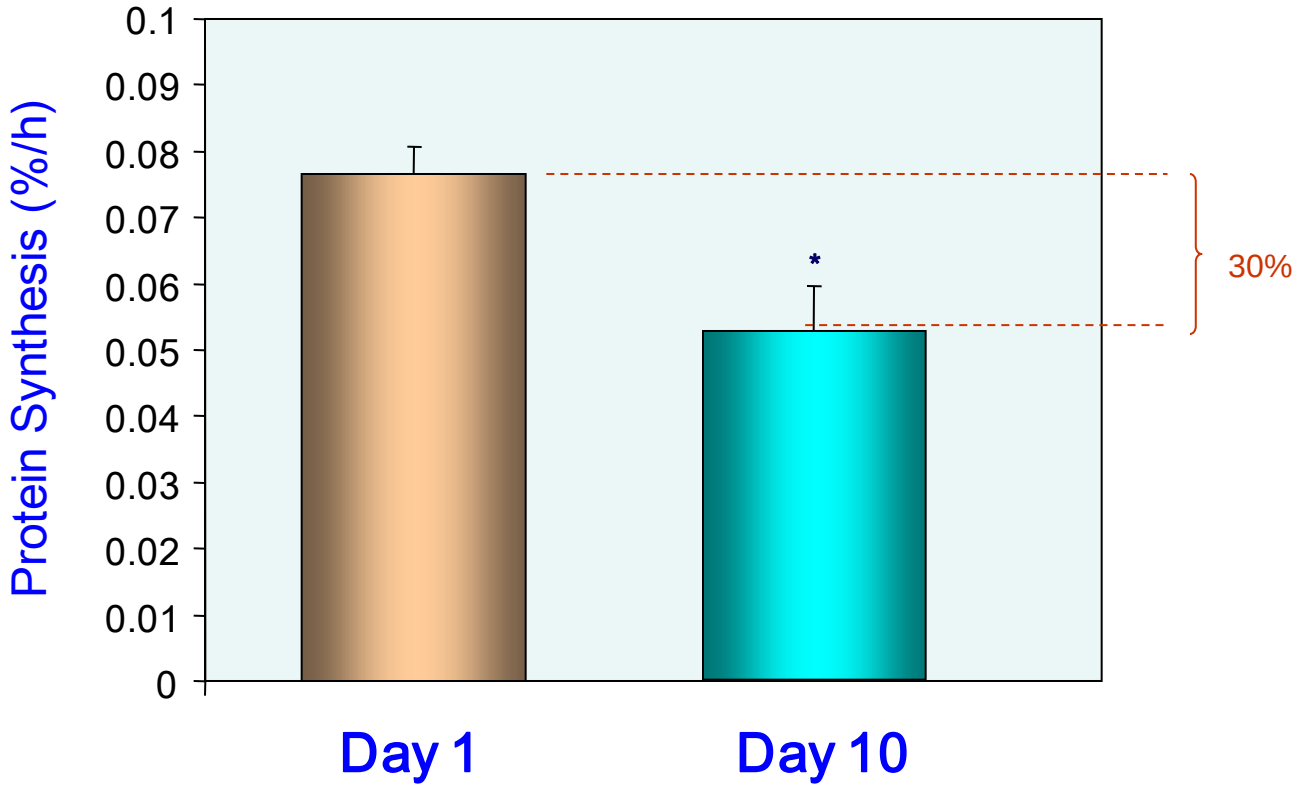
Inactivity reduces muscle protein synthesis



24 h muscle protein synthesis during 10 day of inactivity in elders
(stable isotope methodology)

Kortebein et al. 2007

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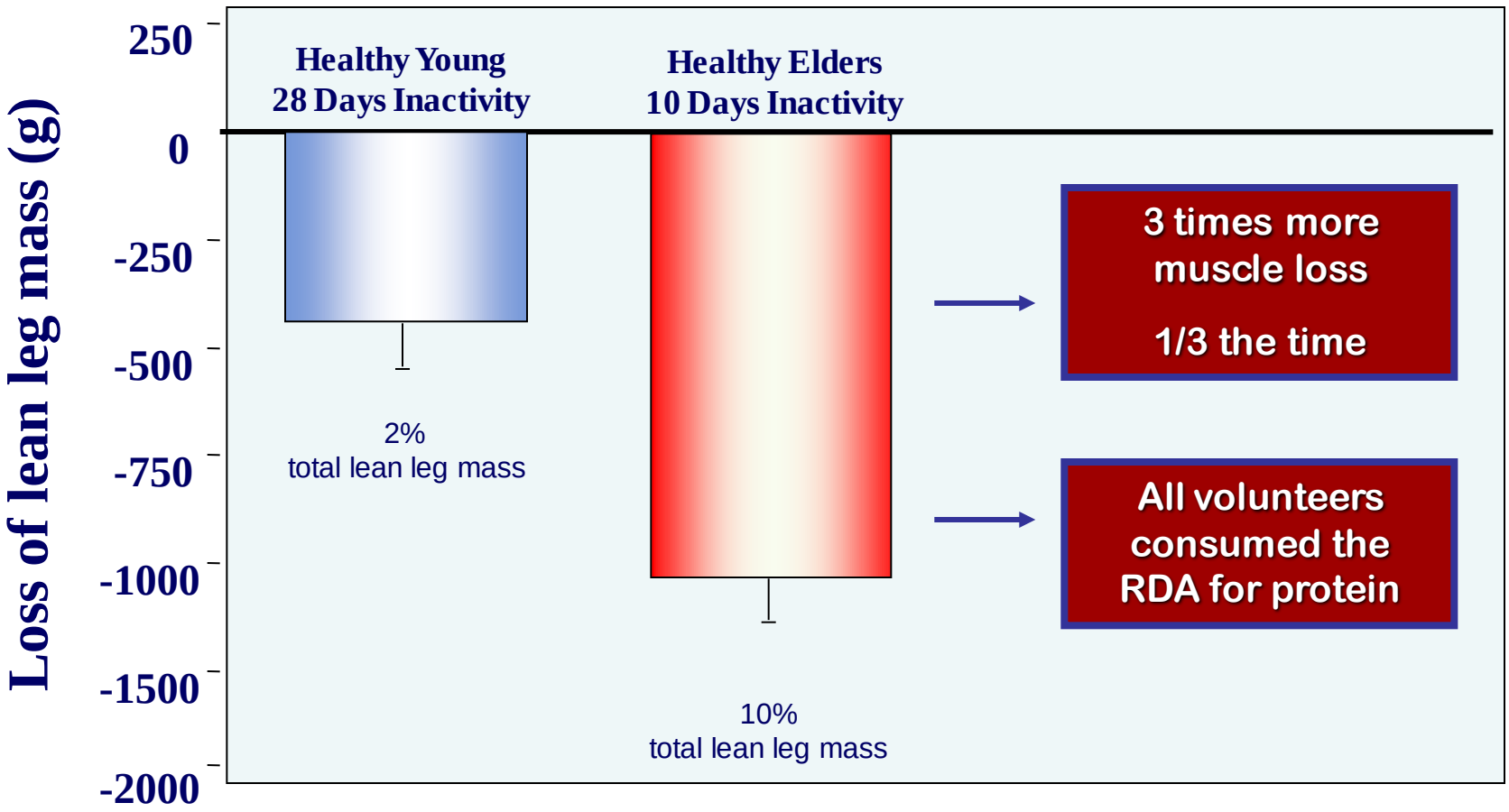
Inactivity and Aging Muscle Mass



Paddon-Jones et. al. 2004
Kortebein et al. 2007

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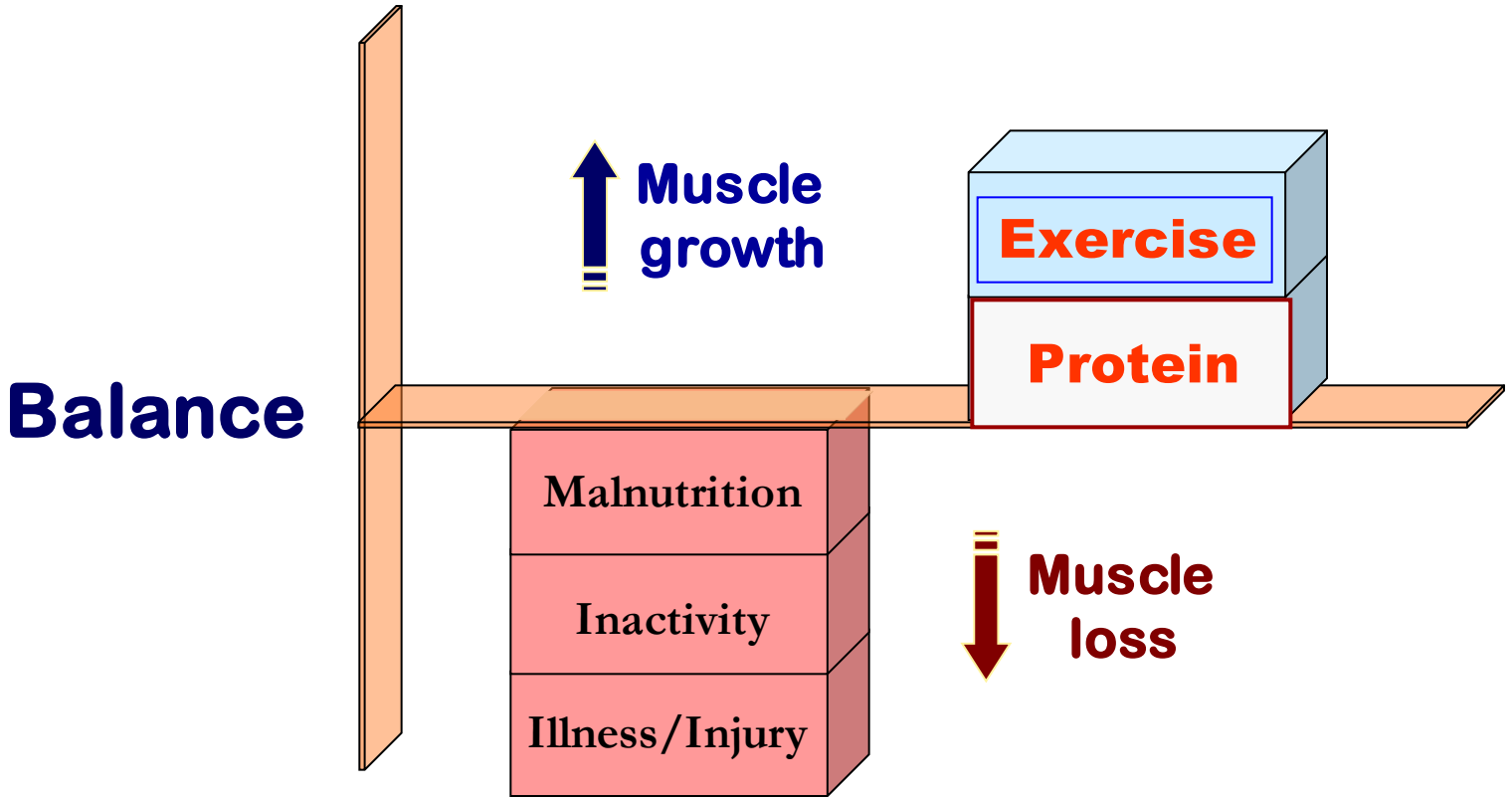
Maintaining Muscle Mass and Function



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Randomized-controlled trials of exercise

Physiological benefits 12 RCTs, 1230 persons

Blumenthal et al 89/91	101 nondisabled m+w, 67 y	↑ $VO_{2\ peak,}$ ↑ bone density, ↑ lipid profile
Chow et al. 87	58 healthy w, 56 y	↑ $VO_{2\ peak,}$ ↑ bone mass
Cunningham et al. 87	224 m, 63 y	↑ $VO_{2\ peak}$
Cress et al. 99	49 healthy m+w, 76 y	↑ $VO_{2\ peak}$
Hagberg et al. 89	37 healthy m+w, 74 yr	↑ $VO_{2\ peak,}$ ↓ heart rate
Hambrecht et al. 00	19 CAD p, 61 y	↑ coronary vasodilatation
King et al. 91	357 nondisabled m+w, 57 y	↑ $VO_{2\ peak}$
Minor et al. 89	120 osteoarthritis p, 61 y	↑ $VO_{2\ peak}$
Pollock et al. 91	57 healthy m+w, 72 y	↑ $VO_{2\ peak}$
Schuit et al. 99	51 healthy m+w, 67 y	↑ heart rate variability
Stein et al. 99	32 healthy m+w, 66 y	↑ heart rate variability
Toshima et al. 90	129 COPD p m+w, 63 yr	↑ $VO_{2\ peak}$

Landi et al. Curr Opin Clin Nutr Metab Care 2013, in press

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Randomized-controlled trials of exercise

Benefits on functional impairment 10 RCTs, 1150 persons

Brown et al. 00	84 frail m+w, 83 y	↑ muscle strength, ↑ reaction time, ↑ balance
Buchner et al. 97	105 impaired m+w, 75 y	↑ muscle strength
Cress et al. 99	49 healthy m+w, 76	↑ muscle strength
Fiatarone et al 94	100 frail nursing home p, 87y	↑ muscle strength
Jette et al. 97	102 nondisabled m+w, 72 y	↑ muscle strength
Jette et al. 99	215 disabled m+w, 75 y	↑ muscle strength
Lord et al. 95	197 healthy w, 72 y	↑ muscle strength, ↑ balance
Pollock et al. 91	57 healthy m+w, 72 y	↑ muscle strength
Rooks et al. 91	131 healthy m+w, 74 y	↑ muscle strength, ↑ reaction time, ↑ balance
Wolfson et al. 96	110 healty m+w, 80 y	↑ muscle strength, ↑ balance

Landi et al. Curr Opin Clin Nutr Metab Care 2013, in press

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Randomized-controlled trials of exercise

Benefits on physical performance 9 RCTs, 1324 persons

Brown et al. 00	84 frail m+w, 83 y	↑ walking speed, ↑ chair rise
Cress et al. 99	48 healthy m+w, 76 y	↑ performance battery
Fiatarone et al. 94	100 frail nurs. home p, 87y	↑ walking + stair climb
Kovar et al. 92	102 osteoarthrtis p, 69 y	↑ walking speed
Minor et al. 89	120 osteoarthitis p, 61 y	↑ walking speed
Rooks et al. 97	131 healthy m+w, 74 y	↑ stair climbing speed
Wolf et al. 96	200 nondisabled m+w, 76 y	↑ walking speed
Wolfson et al. 96	110 healthy m+w, 80 y	↑ walking speed

Landi et al. Curr Opin Clin Nutr Metab Care 2013, in press

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Randomized-controlled trials of exercise

Benefits on physical performance 8 RCTs,

2000-2013

Hughes 2001	120 sedentary, m+f, 46-78y	↑ muscle strength – m m
Metter 2002	1071 sedentary, m, 20-100y	↑ muscle strength – m m
Metter 2004	993 sedentary, m 48,6 y	↑ muscle strength – m m
Miller 2010	998 sedentary, m+f 56.6y	↑ muscle strength, function
Reid 2013	48 healthy, m+f, 74y	↑ muscle strength – m m
Sarti 2013	92 active, m+f, 70y	↑ muscle strength – m m
Tager 2004	16 sedentary, m+f, 70y	↑ muscle strength – function
LIFE Study 2010	**424 sedentary m+w, 80 y**	**SPPB score**

Landi et al. Curr Opin Clin Nutr Metab Care 2013, in press

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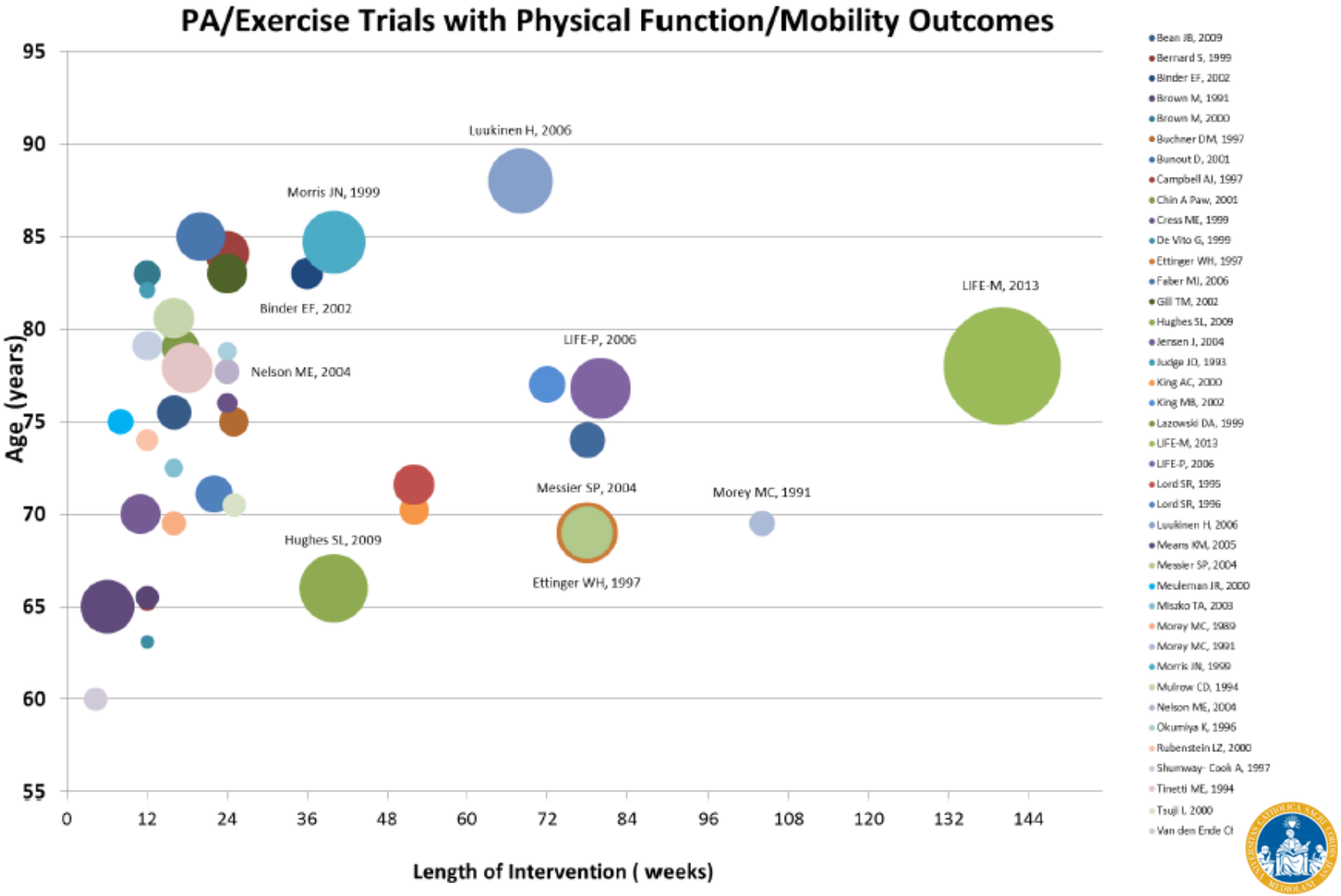
Exercise programs and EBM
RCT



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Exercise programs and EBM
RCT

Journal of Gerontology: MEDICAL SCIENCES
2006, Vol. 61A, No. 11, 1157–1165

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Exercise: An Active Route to Healthy Aging

Effects of a Physical Activity Intervention on Measures of Physical Performance: Results of the Lifestyle Interventions and Independence for Elders Pilot (LIFE-P) Study

The LIFE Study Investigators*
[*See Appendix for List of LIFE Study Investigators]

THE LIFE STUDY

Life Study Investigators. J Gerontol, 2006

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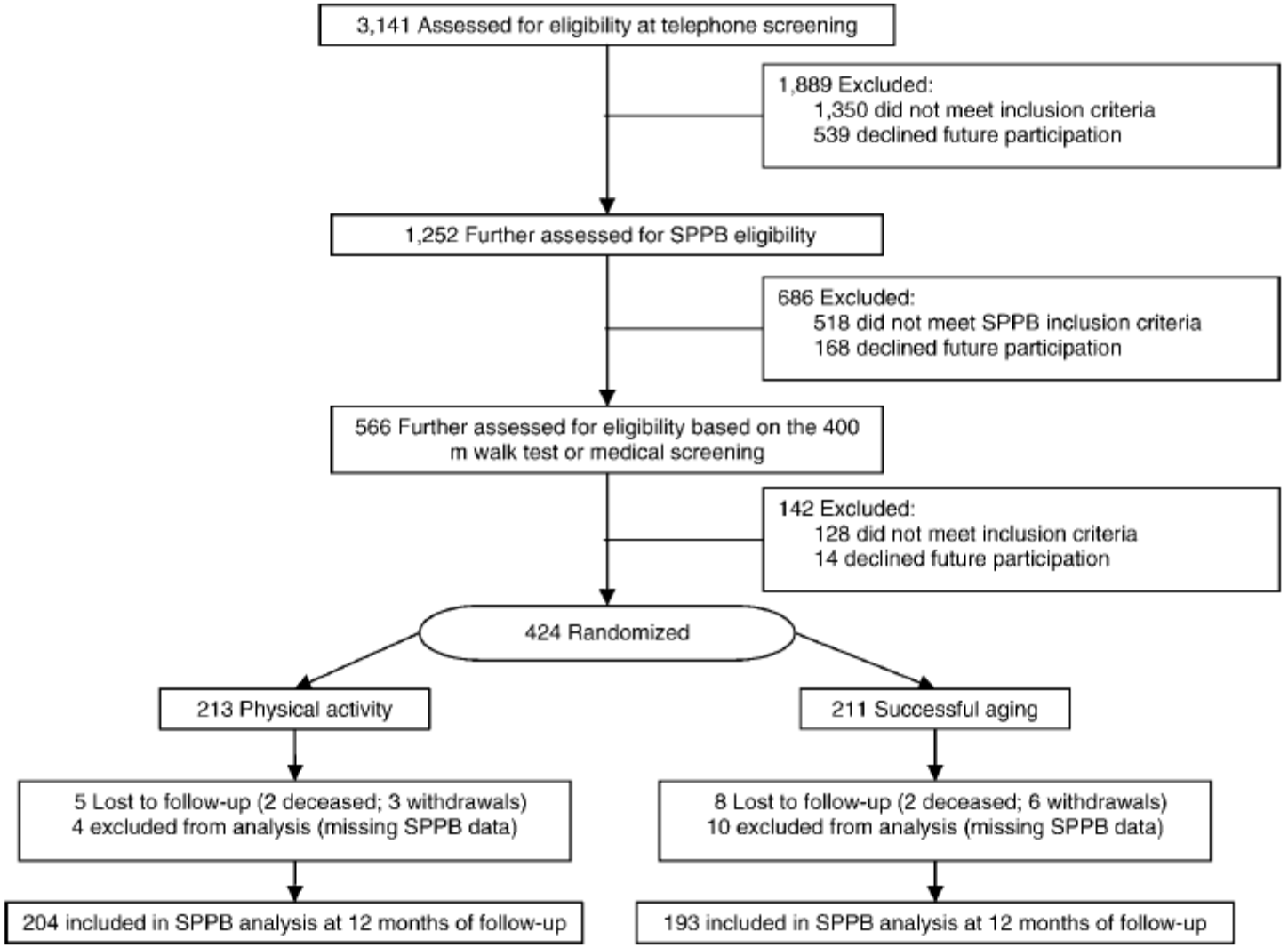
Exercise programs and EBM
RCT



Life Study Investigators. J Gerontol, 2006

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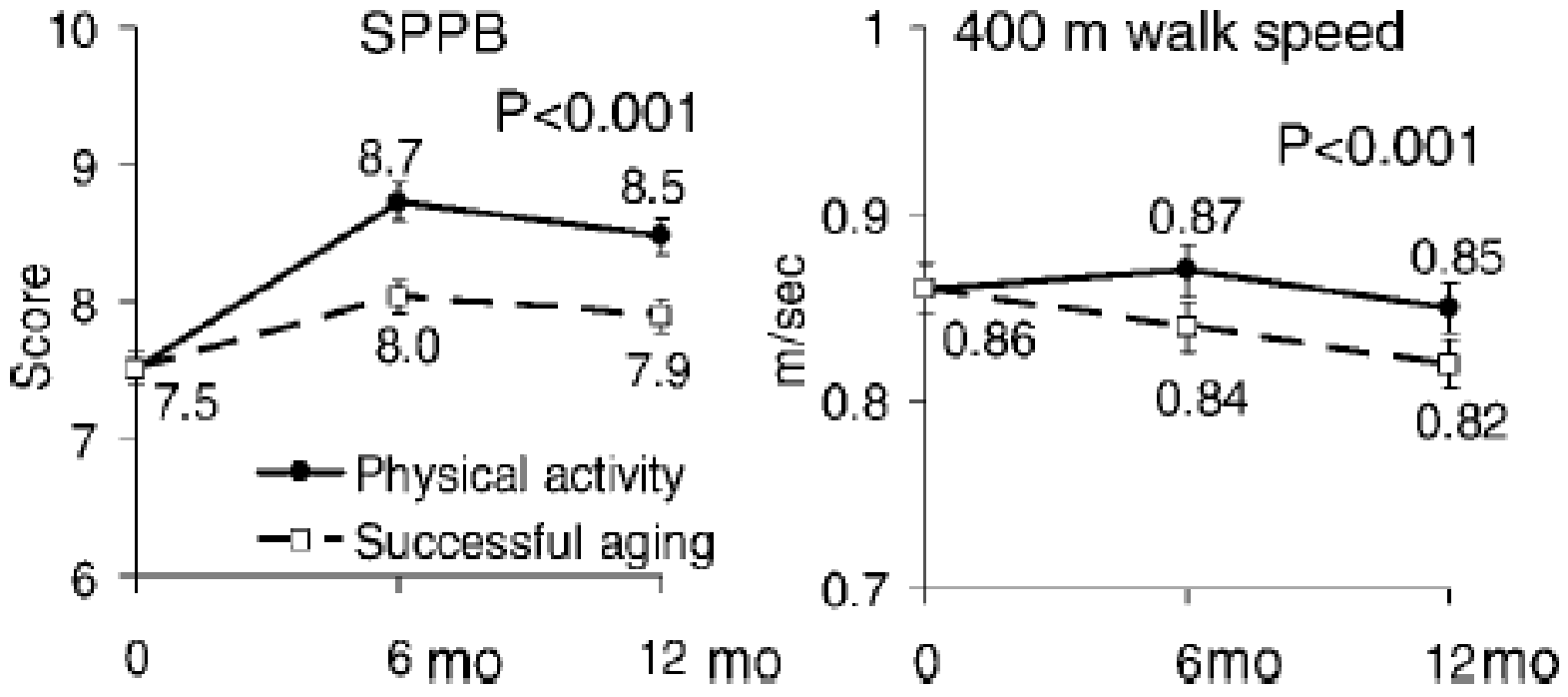
Exercise programs and EBM
RCT

Short Physical Performance Battery (SPPB) score and 400 m walk speed according to randomized groups at baseline and during follow-up.



Life Study Investigators. J Gerontol, 2006

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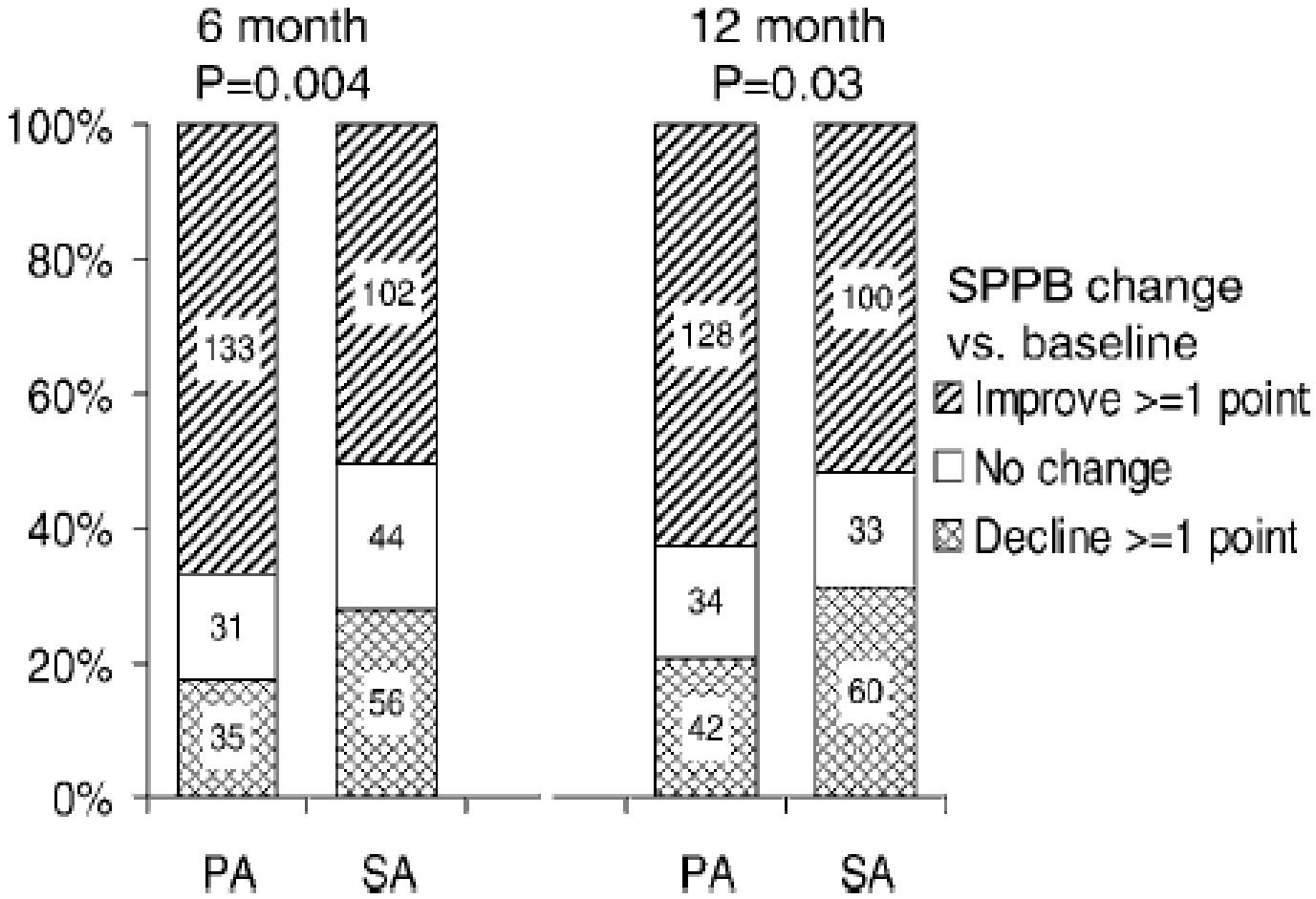
Number of participants who improved by1 point, did not change, or declined by1 point in the SPPB score from baseline to 6 and 12 months of follow-up.



Life Study Investigators. J Gerontol, 2006

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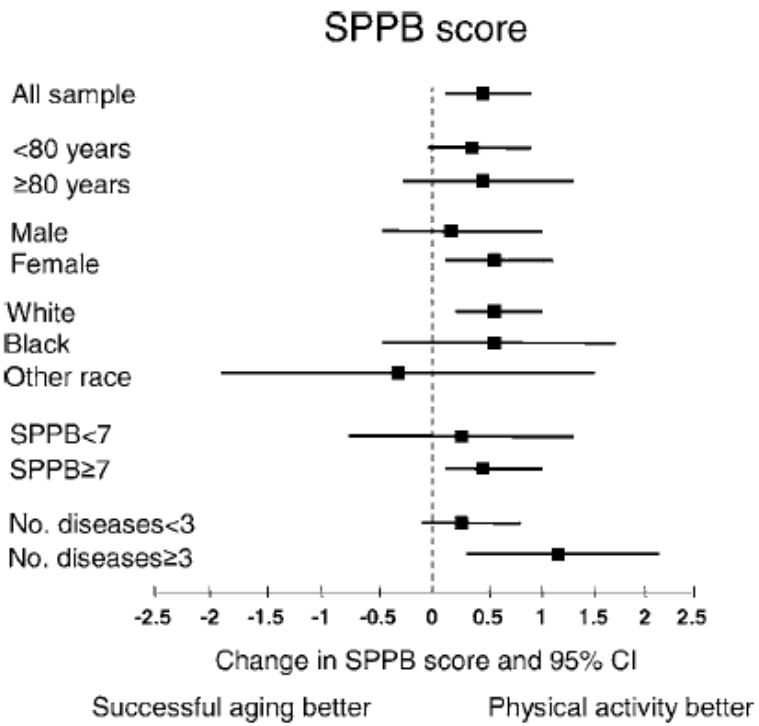
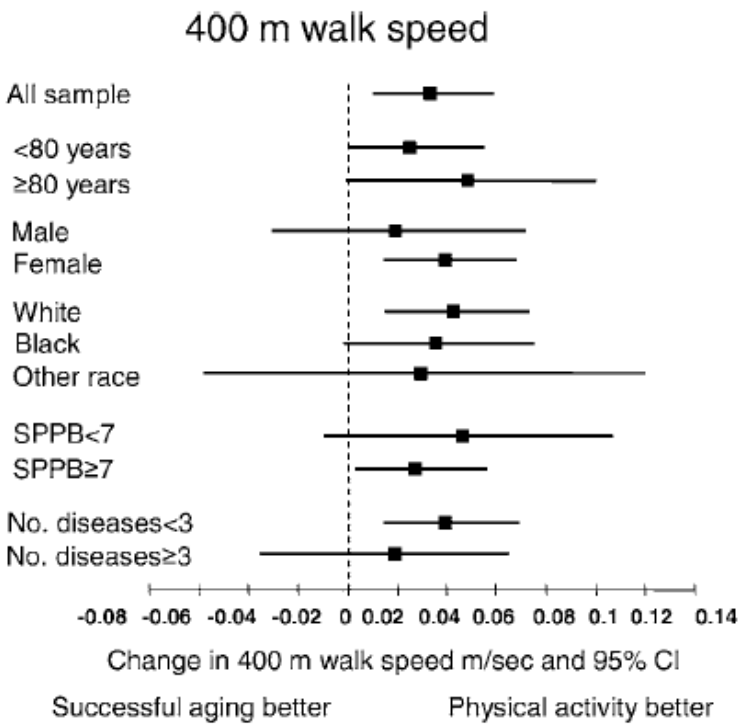
Exercise programs and EBM
RCT

Effects of the intervention on the SPPB score and 400 m walk speed expressed as mean change in the PA group minus mean change in the SA group from baseline to 12 months according to selected baseline characteristics.





Life Study Investigators. J Gerontol, 2006

Exercise programs and EBM
Observational Study

Physical activity prevented functional decline among frail community-living elderly subjects in an international observational study

Francesco Landi[a,*], Graziano Onder[a], Iain Carpenter[b], Matteo Cesari[a,c], Manuel Soldato[a], Roberto Bernabei[a]

[a]*Department of Gerontology-Geriatric, Catholic University Sacred Heart, Rome, Italy*
[b]*Centre for Health Services Studies, University of Kent, UK*
[c]*Department of Aging and Geriatric Research, University of Florida – College of Medicine, Gainesville, FL, USA*

Accepted 12 September 2006

Abstract

Objectives: The aims of the study were to describe the prevalence of physical activity in a sample of older adults in home care in Europe and to examine the relationship between physical activity and incident disability.

Study Design and Setting: Study population consisted of a random sample of 2,005 subjects aged 65 or older admitted to home care programs in 11 European Home Health Agencies who participated in AgeD in HOme Care project. Participants who reported spending 2 or more hours of physical activities in last 3 days were defined physically active. Disability performing activities of daily living was defined as the need of assistance in one or more of the following ADL: eating, dressing, transferring, mobility in bed, personal hygiene, and toileting.

Results: More than 50% of participants were physically active. During a median follow-up of 12 months, 370 subjects (15%) became disabled. After adjusting for age, gender, and other possible confounding variables, active subjects were significantly less likely to become disabled compared to those reporting no or very low-intensity physical activity (OR, 0.67; 95% CI 0.53–0.84).

Conclusions: These findings support the possibility that physical activity has an independent effect on functional autonomy among frail and old people. © 2007 Elsevier Inc. All rights reserved.

Landi et al. J Clin Epidemiol *2007;60:518*

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Exercise programs and EBM
Observational Study

Risk of disability according to physical activity

	Incident disability *N* (%)	Crude model OR (95% CI)	Adjusted model[a] OR (95% CI)
Total sample			
No physical activity ($n = 916$)	205 (22,4%)	1 (Reference)	1 (Reference)
Physical activity ($n = 1,089$)	165 (15,2%)	0.62 (0.48–0.78)	0.67 (0.53–0.84)
Age <80			
No physical activity ($n = 315$)	69 (21,9%)	1 (Reference)	1 (Reference)
Physical activity ($n = 405$)	57 (14,1%)	0.58 (0.40–0.86)	0.62 (0.41–0.93)
Age >80			
No physical activity ($n = 601$)	136 (22,6%)	1 (Reference)	1 (Reference)
Physical activity ($n = 684$)	108 (15,8%)	0.64 (0.48–0.85)	0.70 (0.52–0.94)
Cluster 1			
No physical activity ($n = 717$)	138 (19,2%)	1 (Reference)	1 (Reference)
Physical activity ($n = 880$)	120 (13,6%)	0.66 (0.51–0.87)	0.71 (0.53–0.94)
Cluster 2			
No physical activity ($n = 199$)	67 (33,7%)	1 (Reference)	1 (Reference)
Physical activity ($n = 208$)	45 (21,6%)	0.54 (0.35–0.85)	0.60 (0.37–0.96)

Cluster 1 includes Czech Republic, Denmark, Finland, Iceland, The Netherlands, Norway, and Sweden.
Cluster 2 includes France, Germany, Italy, and United Kingdom.
[a] Adjusted for age, gender, cognitive performance scale score, impaired vision, ischemic heart disease, congestive heart failure, stroke, peripheral vascular disease, COPD, osteoarthritis, depression, number of medications, and country.

Landi et al. J Clin Epidemiol *2007;60:518*

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Exercise programs and EBM
Observational Study

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Physical Activity and Mortality in Frail, Community-Living Elderly Patients

Francesco Landi,[1] Matteo Cesari,[1,2] Graziano Onder,[1,2] Fabrizia Lattanzio,[3] Ester Manes Gravina,[1] and Roberto Bernabei,[1] on Behalf of the SilverNet-HC Study Group

[1]Department of Gerontology, Geriatrics and Physiatrics, Catholic University of the Sacred Heart, Rome, Italy.
[2]Sticht Center on Aging, Wake Forest University–Baptist Medical Center, Winston–Salem, North Carolina.
[3]Pfizer Italiana SpA, Rome, Italy.

Background. The authors describe the prevalence of moderate-intensity physical activity in a population of older persons living in the community. In addition, they explore the relationship between physical activity and mortality.

Methods. In this longitudinal observational study, the authors analyzed data from patients admitted to home care programs collected as part of the Italian Silver Network Home Care project. Twelve home health agencies participated in the project, which evaluated the implementation of the Minimum Data Set for Home Care (MDS-HC) instrument. A total of 2757 patients were enrolled in the current study. The primary outcome measures were the prevalence of 2 or more hours per week of physical activity and survival.

Results. Fewer than 20% of patients had regular physical activity. During a median follow-up period of 10 months from the initial MDS-HC assessment, 442 (16%) patients died. After adjusting for sex, physical and cognitive disability, and all potential risk factors for death, active patients were less likely to die compared with those with no or very low-intensity physical activity (relative risk ratio [RR], 0.51; 95% confidence interval [CI], 0.35–0.73). This inverse relationship was also significant in patients aged 80 years and older (RR 0.55; 95% CI, 0.32–0.95).

Conclusions. Physical activity is associated with a significantly lower risk of all-cause mortality. The current findings support the possibility that moderate-intensity physical activity has an independent effect on survival even among frail and old persons.

Landi et al. J Gerontol, *2004*

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Exercise programs and EBM
Observational Study

Crude and adjusted relative risk of mortality

Age Group	Dead ($N = 442$)	Alive ($N = 2315$)	Crude Model RR (95% CI)	Adjusted Model* RR (95% CI)
All patients				
Sedentary	396	1828	1.0 (Referent)	1.0 (Referent)
Active	46	487	0.43 (0.31–0.60)	0.51 (0.35–0.73)
<70 years				
Sedentary	77	309	1.0 (Referent)	1.0 (Referent)
Active	11	116	0.38 (0.19–0.74)	0.48 (0.21–1.11)
70–80 years				
Sedentary	110	676	1.0 (Referent)	1.0 (Referent)
Active	15	198	0.46 (0.26–0.81)	0.50 (0.26–0.97)
>80 years				
Sedentary	209	843	1.0 (Referent)	1.0 (Referent)
Active	20	173	0.46 (0.28–0.75)	0.55 (0.32–0.95)

Landi et al. J Gerontol, *2004*

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Exercise programs and EBM
Observational Study

Contents lists available at ScienceDirect

Preventive Medicine

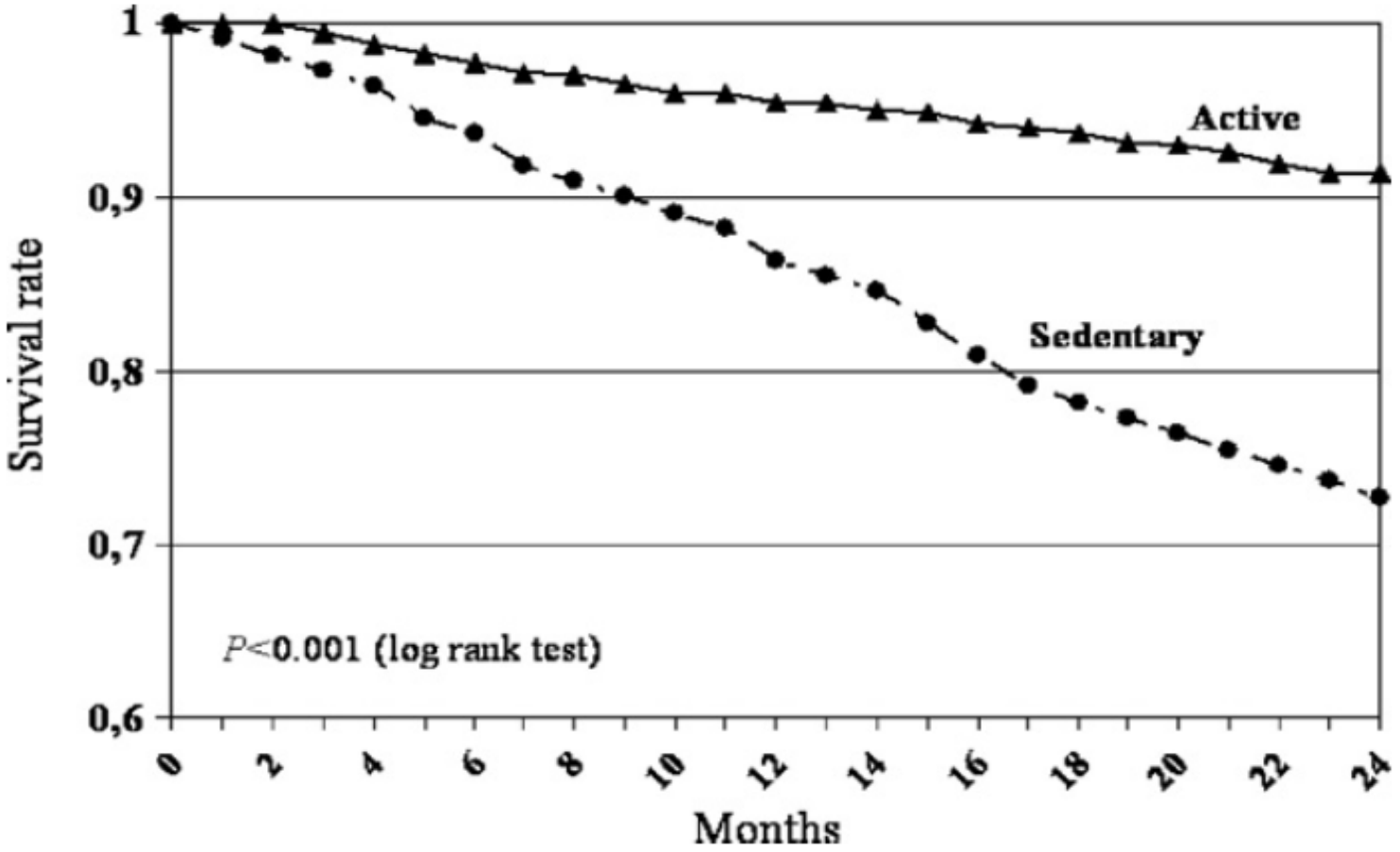
journal homepage: www.elsevier.com/locate/ypmed

Walking one hour or more per day prevented mortality among older persons: Results from ilSIRENTE study

Francesco Landi [a,*], Andrea Russo [a], Matteo Cesari [b], Marco Pahor [b,c], Rosa Liperoti [a], Paola Danese [a], Roberto Bernabei [a], Graziano Onder [a]

Landi F et al. Preventive Medicine 47 (2008) 422–426

Exercise programs and EBM
Observational Study



Landi F et al. Preventive Medicine 47 (2008) 422–426

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Exercise programs and EBM
Observational Study

	Dead (n=30)	Alive (n=218)	Crude Model RR (95% CI)	Adjusted Model[a] RR (95% CI)
Model 1				
Sedentary	18	65	1.0 (Referent)	1.0 (Referent)
Active	12	153	0.28 (0.12–0.62)	0.36 (0.12–0.98)
Model 2				
No walkers	5	10	1.0 (Referent)	1.0 (Referent)
Walkers for 30 min	13	55	0.47 (0.13–1.62)	0.33 (0.07–1.57)
Walkers for 1 h	10	104	0.19 (0.05–0.67)	0.16 (0.04–0.79)
Walkers for more than 1 h	2	49	0.08 (0.01–0.48)	0.11 (0.02–0.95)

Sedentary: subjects walking less than 1 h per day;

Active: subjects walking 1 h or more per day.

Landi F et al. Preventive Medicine 47 (2008) 422–426

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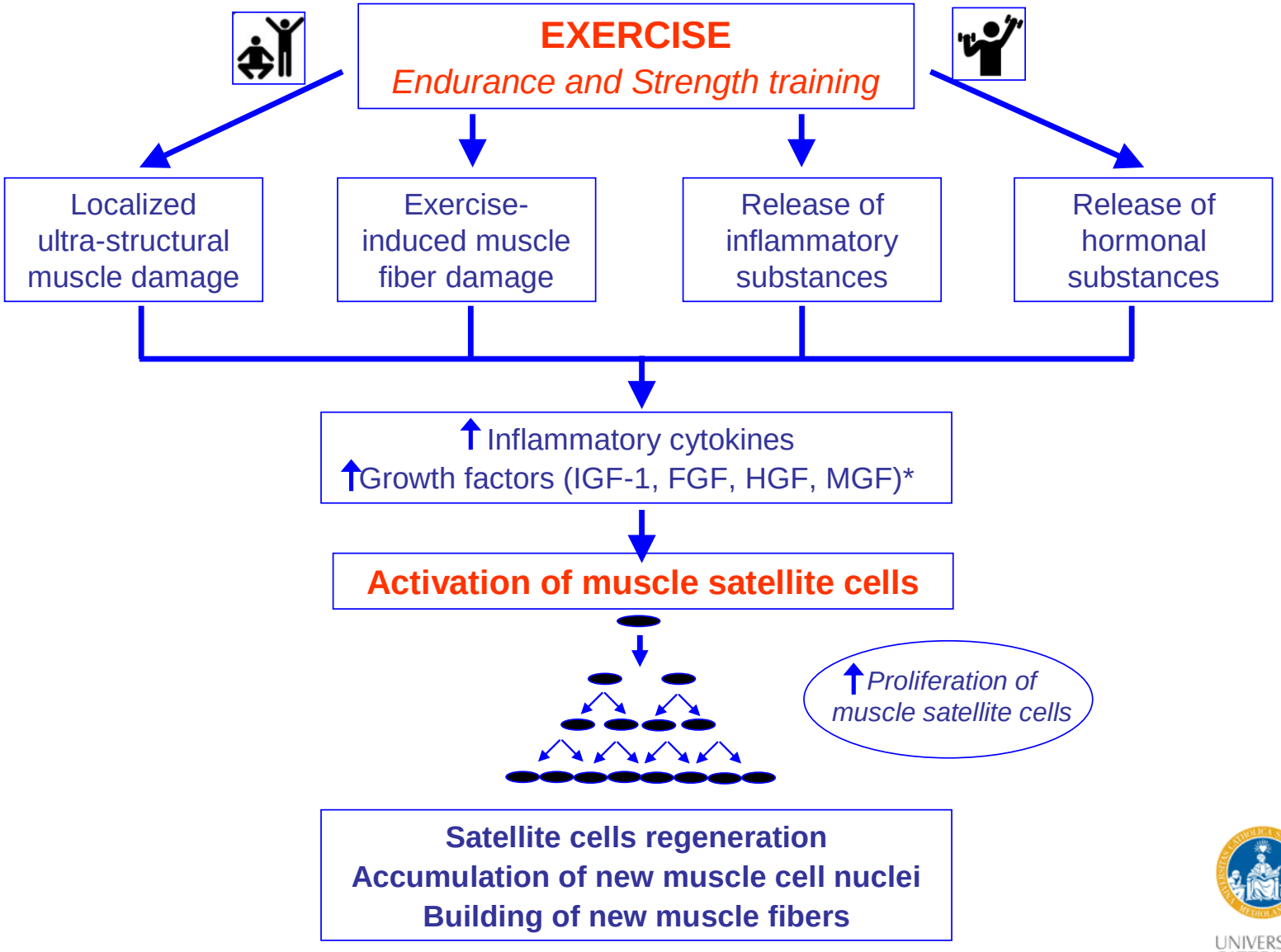
Potential effects of exercise



Landi et al. Curr Opin Clin Nutr Metab Care 2013, in press

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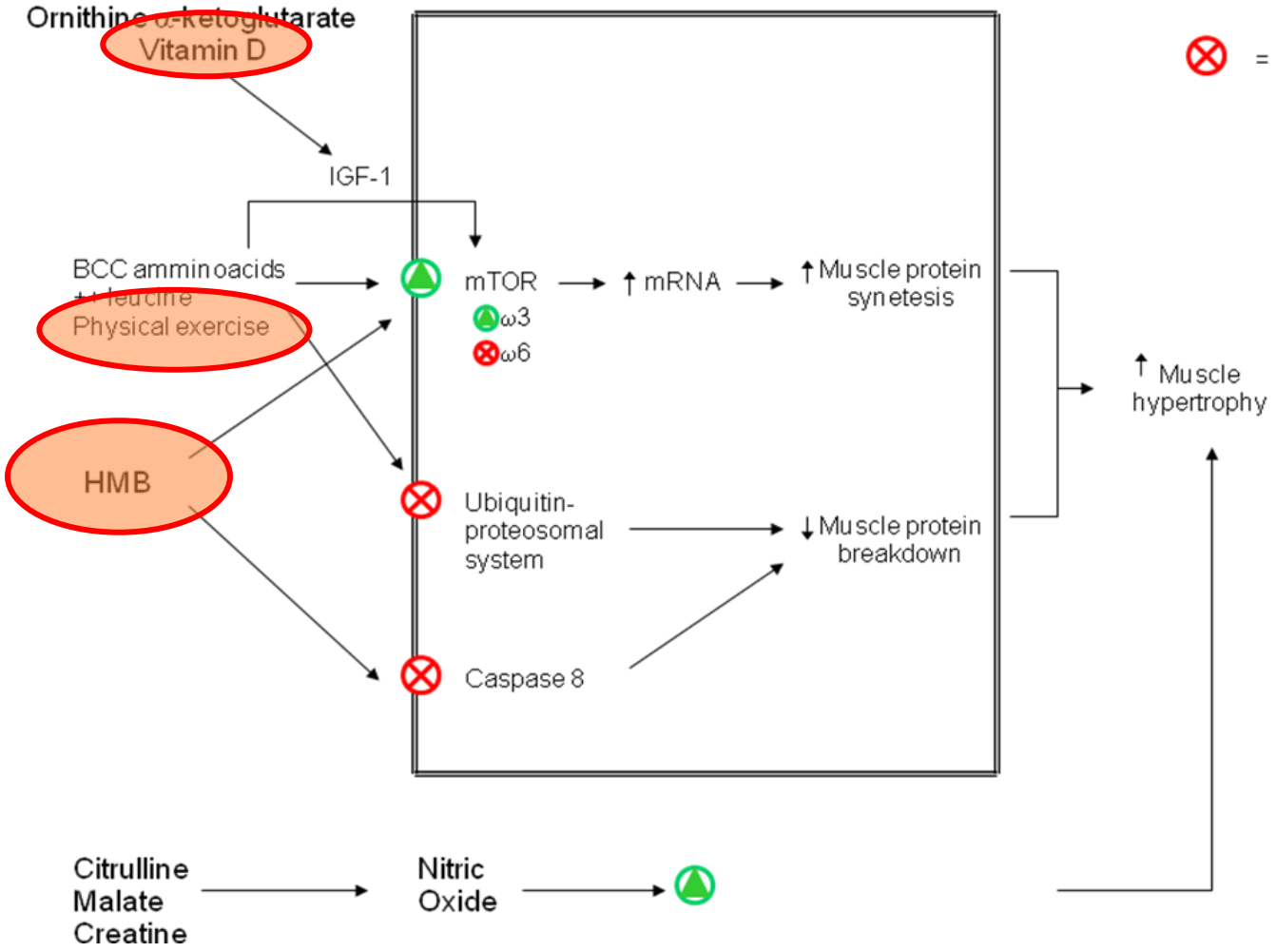
Potential effects of exercise

Overview of potential pathways whereby exercise and nutritional interventions may influence cellular events implicated in the regulation of muscle mass.



Landi F. et al. THE NEW METABOLIC TREATMENTS FOR SARCOPENIA Aging Clin Exp Res 2013.

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Interaction exercise and protein

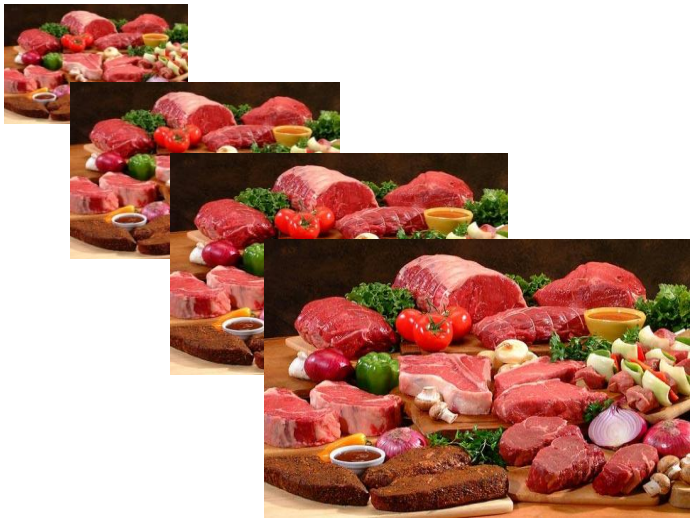
ELSEVIER

JAMDA

journal homepage: www.jamda.com

Perspective: Protein: What Kind, How Much, When?

Francesco Landi, MD, PhD
Emanuele Marzetti, MD, PhD
Roberto Bernabei, MD
Department of Geriatrics
Catholic University of the Sacred Heart
Rome, Italy



Landi F. et al. JAMDA 2012

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Interaction exercise and protein

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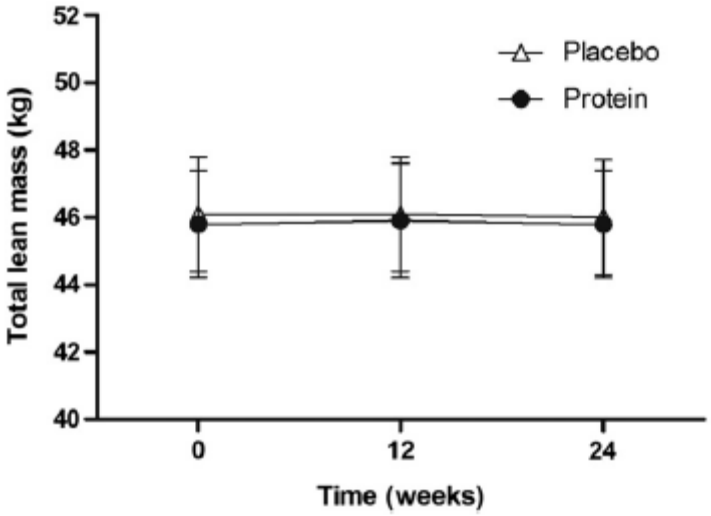
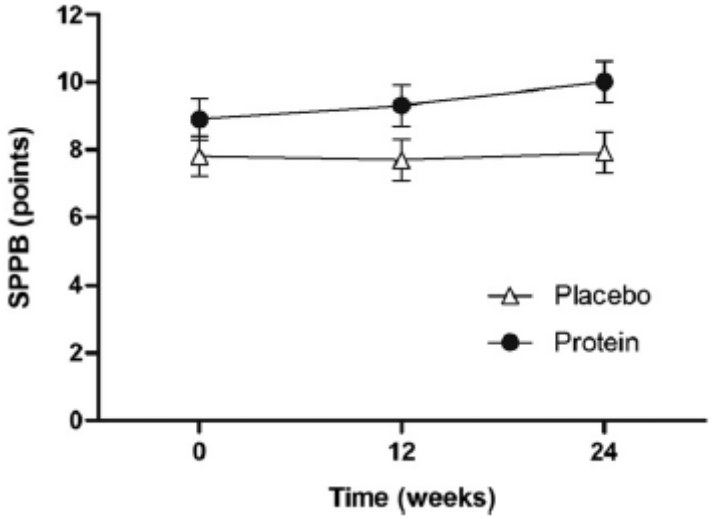
journal homepage: www.jamda.com

Original Study

Protein Supplementation Improves Physical Performance in Frail Elderly People: A Randomized, Double-Blind, Placebo-Controlled Trial





Tieland et al. JAMDA 2012

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Interaction exercise and protein

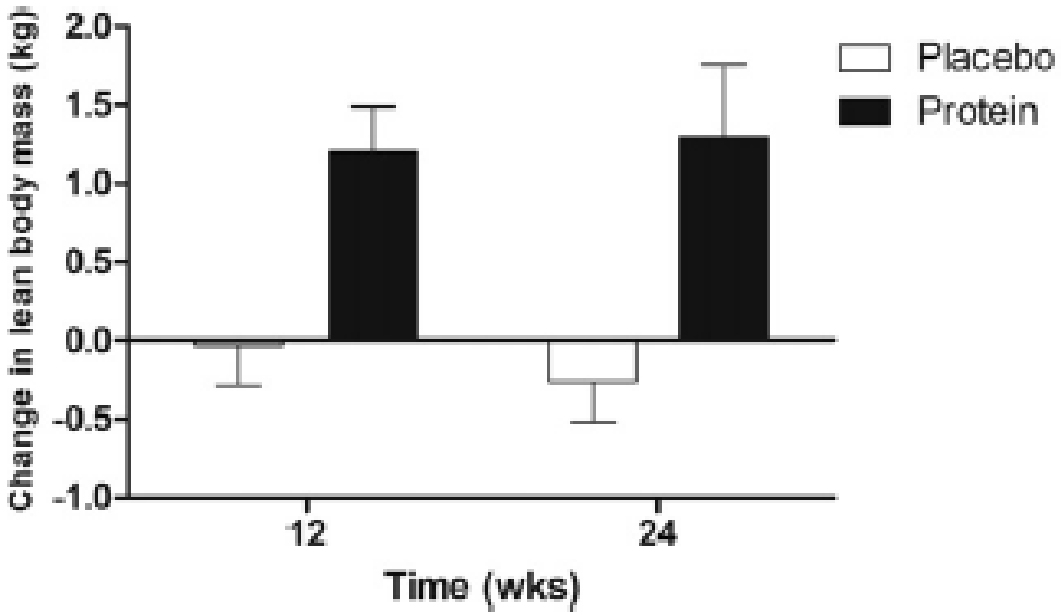
ELSEVIER

JAMDA

journal homepage: www.jamda.com

Original Study

Protein Supplementation Increases Muscle Mass Gain During Prolonged Resistance-Type Exercise Training in Frail Elderly People: A Randomized, Double-Blind, Placebo-Controlled Trial



Tieland et al. JAMDA 2012

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Approach to the Assessment and Management of Mobility in Older Adults

Clinical Review & Education

Care of the Aging Patient: From Evidence to Action

Mobility Limitation in the Older Patient
A Clinical Review

Cynthia J. Brown, MD, MSPH; Kellie L. Flood, MD

CONCLUSIONS AND RELEVANCE Identification of older adults at risk for mobility limitation can be accomplished through routine screening in the ambulatory setting. Addressing functional deficits and environmental barriers with exercise and mobility devices can lead to improved function, safety, and quality of life for patients with mobility limitations.

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Approach to the Assessment and Management of Mobility in Older Adults

Physical Performance Screening Tool

Physical Performance Assessment

4-meter walking speed

SPPB

Screening Questions[7,32]

Self-reported difficulty with mobility can be ascertained by asking, "For health or physical reasons, do you have difficulty climbing up 10 steps? Walking ¼ mile?"

Among older adults who report no difficulty in mobility tasks, preclinical limitations can be elicited by asking, "Because of underlying health or physical reasons, have you modified the way you climb 10 steps? Walk ¼ mile? Either by changing the method or frequency of these activities?"

Physical Examination[34]

Patients are asked to walk 3 m (10 ft) at a comfortable pace while being timed. Gait speeds of 1.0 m/s or faster have consistently been shown to be associated with survival that was longer than expected based on age and sex alone.[36]

Gait speed is one component of the well-validated Short Physical Performance Battery.[34] In addition to gait speed, the battery includes 5 timed chair stands and progressive balance tests. The scores for the battery range from 0 to 12, with higher scores indicating better function.

Gait speed can be assessed in a busy clinic setting by having a 3-m space marked off and incorporating gait speed into the routine assessments performed by clinic staff. For example, a patient's gait speed could be measured while the patient is walking to be weighed.

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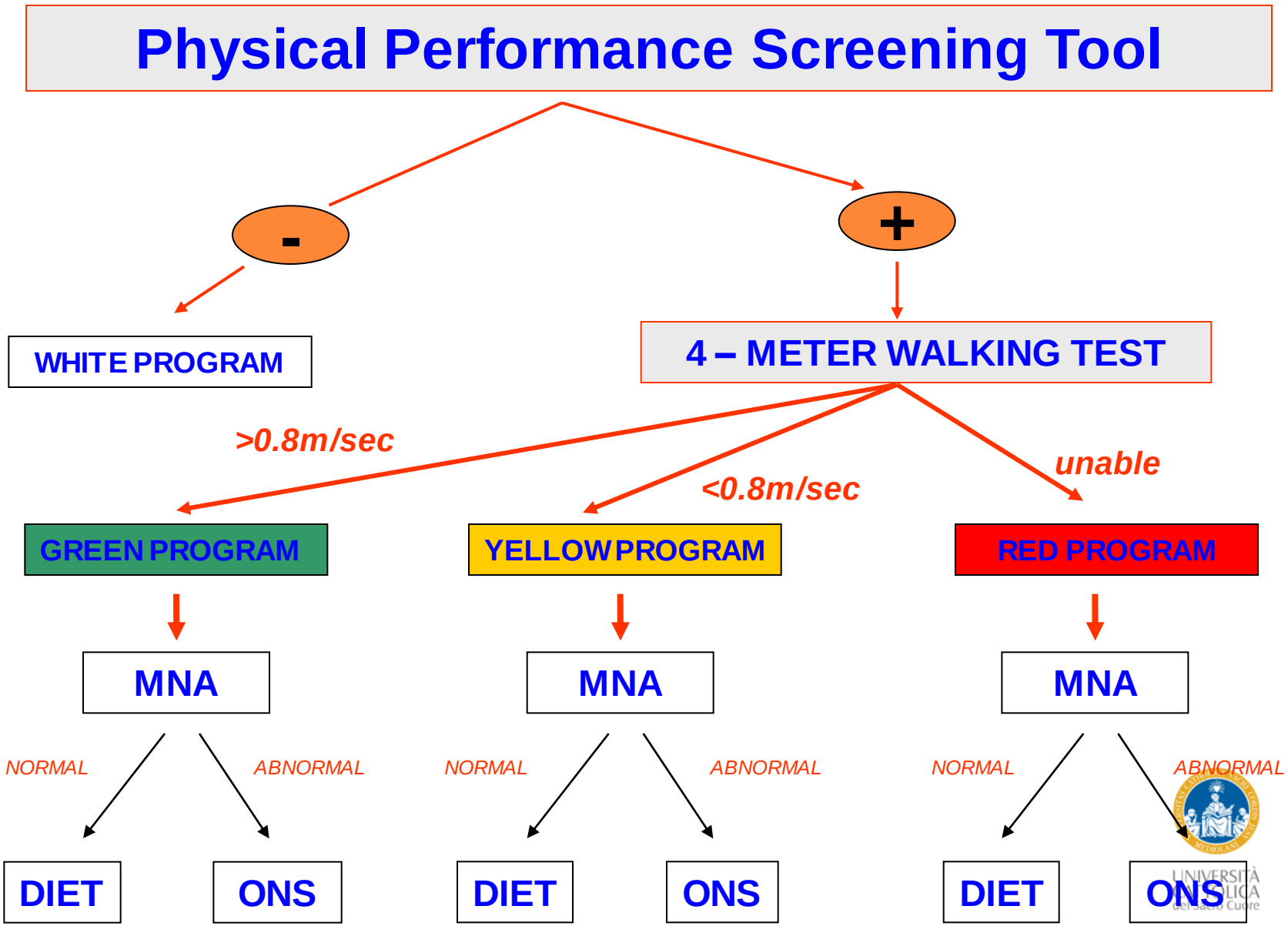

Approach to the Assessment and Management of Mobility in Older Adults

REVIEW

CURRENT OPINION

Exercise as a remedy for sarcopenia

Francesco Landi, Emanuele Marzetti, Anna M. Martone, Roberto Bernabei, and Graziano Onder

Purpose of review
Although prolongation of life is significant public health aim, at the same time the extended life should involve preservation of the capacity to live independently. Consequently, the identification of cost-effectiveness interventions to prevent frailty is one of the most important public health challenges. In the present review, we present the available evidence regarding the impact of physical exercise on the components of frailty syndrome and, in particular, as a remedy for sarcopenia.

Recent findings
Resistance exercise training is more effective in increasing muscle mass and strength, whereas endurance exercises training is superior for maintaining and improving maximum aerobic power. Based on these evidences, recommendations for adult and frail older people should include a balanced program of both endurance and strength exercises, performed on a regular schedule (at least 3 days a week).

Summary
Regular exercise is the only strategy found to consistently prevent frailty and improve sarcopenia and physical function in older adults. Physical exercises increase aerobic capacity, muscle strength and endurance, by ameliorating aerobic conditioning and/or strength. In older patients, exercise and physical activity produce at least the same beneficial effects observed in younger individuals.

Keywords
endurance training, exercise, resistance training, sarcopenia

Landi F et al. Current Opinion 2013, in press

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Take Home Messages

- Sarcopenia has been indicated as a reliable marker of frailty and poor prognosis among older individuals.
- Resistance exercises are effective in increasing muscle mass and strength.
- Endurance exercises are superior for maintaining and improving maximum aerobic power.
- Recommendations for frail older patients include a balanced program of both endurance and strength exercises, performed at least 3 days a week.

Landi F et al. Current Opinion 2013, in press

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